

# THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

## Oklahoma Agricultural Experiment Station

Whereas, THERE HAS BEEN PRESENTED TO THE

Secretary of Agriculture

AN APPLICATION REQUESTING A CERTIFICATE OF PROTECTION FOR AN ALLEGED DISTINCT VARIETY OF SEXUALLY REPRODUCED, OR TUBER PROPAGATED PLANT, THE NAME AND DESCRIPTION OF WHICH ARE CONTAINED IN THE APPLICATION AND EXHIBITS, A COPY OF WHICH IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED HAVE BEEN COMPLIED WITH, AND THE TITLE THERETO IS, FROM THE RECORDS OF THE PLANT VARIETY PROTECTION OFFICE, IN THE APPLICANT(S) INDICATED IN THE SAID COPY, AND WHEREAS, UPON DUE EXAMINATION MADE, THE SAID APPLICANT(S) IS (ARE) ADJUDGED TO BE ENTITLED TO A CERTIFICATE OF PLANT VARIETY PROTECTION UNDER THE LAW.

NOW, THEREFORE, THIS CERTIFICATE OF PLANT VARIETY PROTECTION IS TO GRANT UNTO THE SAID APPLICANT(S) AND THE SUCCESSORS, HEIRS OR ASSIGNS OF THE SAID APPLICANT(S) FOR THE TERM OF TWENTY YEARS FROM THE DATE OF THIS GRANT, SUBJECT TO THE PAYMENT OF THE REQUIRED FEES AND PERIODIC REPLENISHMENT OF VIABLE BASIC SEED OF THE VARIETY IN A PUBLIC REPOSITORY AS PROVIDED BY LAW, THE RIGHT TO EXCLUDE OTHERS FROM SELLING THE VARIETY, OR OFFERING IT FOR SALE, OR REPRODUCING IT, OR IMPORTING IT, OR EXPORTING IT, OR CONDITIONING IT FOR PROPAGATION, OR STOCKING IT FOR ANY OF THE ABOVE PURPOSE, OR CONDITIONING IT FOR PROPAGATION, OR STOCKING IT FOR ANY OF THE ABOVE PURPOSE, OR USING IT IN PRODUCING A HYBRID OR DIFFERENT VARIETY THEREFROM, TO THE EXTENT PROVIDED BY THE PLANT VARIETY PROTECTION ACT. IN THE UNITED STATES SEED OF THIS VARIETY SHALL BE SOLD BY VARIETY NAME ONLY AS A CLASS OF CERTIFIED SEED AND (2) SHALL CONFORM TO THE NUMBER OF GENERATIONS SPECIFIED BY THE OWNER OF THE RIGHTS. (84 STAT. 1542, AS AMENDED, 7 U.S.C. 2321 ET SEQ.)

BERMUDAGRASS

'Yukon'

In Testimony Whereof, I have hereunto set my hand and caused the seal of the Plant Variety Protection Office to be affixed at the City of Washington, D.C. this twenty-seventh day of April, in the year two thousand and five.

Attest:

*[Signature]*  
Commissioner  
Plant Variety Protection Office  
Agricultural Marketing Service

*[Signature]*  
Secretary of Agriculture



U.S. DEPARTMENT OF AGRICULTURE  
AGRICULTURAL MARKETING SERVICE  
SCIENCE AND TECHNOLOGY - PLANT VARIETY PROTECTION OFFICE

**APPLICATION FOR PLANT VARIETY PROTECTION CERTIFICATE**  
(Instructions and information collection burden statement on reverse)

The following statements are made in accordance with the Privacy Act of 1974 (5 U.S.C. 552a) and the Paperwork Reduction Act (PRA) of 1995.

Application is required in order to determine if a plant variety protection certificate is to be issued (7 U.S.C. 2421). Information is held confidential until certificate is issued (7 U.S.C. 2426).

1. NAME OF OWNER Oklahoma Agricultural Experiment Station		2. TEMPORARY DESIGNATION OR EXPERIMENTAL NAME OKS 91-11	3. VARIETY NAME Yukon
4. ADDRESS (Street and No., or R.F.D. No., City, State, and ZIP Code, and Country) Oklahoma State University 139 Agricultural Hall Stillwater OK 74078-6019		5. TELEPHONE (Include area code) 405-744-5398	FOR OFFICIAL USE ONLY VPPO NUMBER 200100234
		6. FAX (Include area code) 405-744-5339	
7. IF THE OWNER NAMED IS NOT A "PERSON", GIVE FORM OF ORGANIZATION (corporation, partnership, association, etc.) Public Research Agency	8. IF INCORPORATED, GIVE STATE OF INCORPORATION	9. DATE OF INCORPORATION	FILING DATE July 26, 2001
10. NAME AND ADDRESS OF OWNER REPRESENTATIVE(S) TO SERVE IN THIS APPLICATION. (First person listed will receive all papers) Dr. R. L. Westerman, Associate Director Oklahoma Agricultural Experiment Station Oklahoma State University 139 Agricultural Hall Stillwater, OK 74078-6019			FILING AND EXAMINATION FEES: \$ 2705- DATE July 26, 2001 CERTIFICATION FEE: \$ 432. DATE March 15, 2002
11. TELEPHONE (Include area code) 405-744-5398	12. FAX (Include area code) 405-744-5339	13. E-MAIL rwester@okstate.edu	14. CROP KIND (Common Name) Bermudagrass
15. GENUS AND SPECIES NAME OF CROP Cynodon dactylon var. dactylon		16. FAMILY NAME (Botanical) Poaceae (Gramineae)	17. IS THE VARIETY A FIRST GENERATION HYBRID? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
18. CHECK APPROPRIATE BOX FOR EACH ATTACHMENT SUBMITTED (Follow instructions on reverse) a. <input checked="" type="checkbox"/> Exhibit A. Origin and Breeding History of the Variety b. <input checked="" type="checkbox"/> Exhibit B. Statement of Distinctness c. <input checked="" type="checkbox"/> Exhibit C. Objective Description of Variety d. <input type="checkbox"/> Exhibit D. Additional Description of the Variety (Optional) e. <input checked="" type="checkbox"/> Exhibit E. Statement of the Basis of the Owner's Ownership f. <input checked="" type="checkbox"/> Voucher Sample (2,500 viable untreated seeds or, for tuber propagated varieties, verification that tissue culture will be deposited and maintained in an approved public repository) g. <input checked="" type="checkbox"/> Filing and Examination Fee (\$2,705), made payable to "Treasurer of the United States" (Mail to the Plant Variety Protection Office)		19. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE SOLD AS A CLASS OF CERTIFIED SEED? See Section 83(e) of the Plant Variety Protection Act <input checked="" type="checkbox"/> YES (If "yes", answer items 20 and 21 below) <input type="checkbox"/> NO (If "no", go to item 22) 20. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE LIMITED AS TO NUMBER OF CLASSES? IF YES, WHICH CLASSES? <input checked="" type="checkbox"/> FOUNDATION <input checked="" type="checkbox"/> REGISTERED <input checked="" type="checkbox"/> CERTIFIED BAD 3/16/05 21. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE LIMITED AS TO NUMBER OF GENERATIONS? IF YES, SPECIFY THE <input type="checkbox"/> FOUNDATION <input checked="" type="checkbox"/> REGISTERED <input checked="" type="checkbox"/> CERTIFIED NUMBER 1,2,3, etc. <input type="checkbox"/> (If additional explanation is necessary, please use the space indicated on the reverse.)	
22. HAS THE VARIETY (INCLUDING ANY HARVESTED MATERIAL) OR A HYBRID PRODUCED FROM THIS VARIETY BEEN SOLD, DISPOSED OF, TRANSFERRED, OR USED IN THE U. S. OR OTHER COUNTRIES? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO IF YES, YOU MUST PROVIDE THE DATE OF FIRST SALE, DISPOSITION, TRANSFER, OR USE FOR EACH COUNTRY AND THE CIRCUMSTANCES. (Please use space indicated on reverse.)		23. IS THE VARIETY OR ANY COMPONENT OF THE VARIETY PROTECTED BY INTELLECTUAL PROPERTY RIGHT (PLANT BREEDER'S RIGHT OR PATENT)? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO IF YES, PLEASE GIVE COUNTRY, DATE OF FILING OR ISSUANCE AND ASSIGNED REFERENCE NUMBER. (Please use space indicated on reverse.)	
24. The owners declare that a viable sample of basic seed of the variety will be furnished with application and will be replenished upon request in accordance with such regulations as may be applicable, or for a tuber propagated variety a tissue culture will be deposited in a public repository and maintained for the duration of the certificate. The undersigned owner(s) is(are) the owner of this sexually reproduced or tuber propagated plant variety, and believe(s) that the variety is new, distinct, uniform, and stable as required in Section 42. Owner(s) is(are) informed that false representation herein can jeopardize protection and result in penalties.			
SIGNATURE OF OWNER Robert L. Westerman		SIGNATURE OF OWNER Robert L. Westerman	
NAME (Please print or type) Robert L. Westerman		NAME (Please print or type) Robert L. Westerman	
CAPACITY OR TITLE Assistant Director	DATE 7-24-01	CAPACITY OR TITLE Assistant Director	DATE 7-24-01

**GENERAL:** To be effectively filed with the Plant Variety Protection Office (PVPO), **ALL** of the following items must be received in the PVPO: (1) Completed application form signed by the owner; (2) completed exhibits A, B, C, E; (3) for a seed reproduced variety at least 2,500 viable untreated seeds, for a hybrid variety at least 2,500 untreated seeds of each line necessary to reproduce the variety, or for tuber reproduced varieties verification that a viable (in the sense that it will reproduce an entire plant) tissue culture will be deposited and maintained in an approved public repository; (4) check drawn on a U.S. bank for \$2,705 (\$320 filing fee and \$2,385 examination fee), payable to "Treasurer of the United States" (See Section 97.6 of the Regulations and Rules of Practice.) Partial applications will be held in the PVPO for not more than 90 days, then returned to the applicant as unfilled. Mail application and other requirements to Plant Variety Protection Office, AMS, USDA, Room 500, NAL Building, 10301 Baltimore Avenue, Beltsville, MD 20705-2351. Retain one copy for your files. All items on the face of the application are self explanatory unless noted below. Corrections on the application form and exhibits must be initialed and dated. **DO NOT** use masking materials to make corrections. If a certificate is allowed, you will be requested to send a check payable to "Treasurer of the United States" in the amount of \$320 for issuance of the certificate. Certificates will be issued to owner, not licensee or agent.

**Plant Variety Protection Office**

**Telephone: (301) 504-5518**

**FAX: (301) 504-5291**

**Homepage: <http://www.ams.usda.gov/science/pvpo/pvp.htm>**

**ITEM**

- 18a. Give: (1) the genealogy, including public and commercial varieties, lines, or clones used, and the breeding method; (2) the details of subsequent stages of selection and multiplication; (3) evidence of uniformity and stability; and (4) the type and frequency of variants during reproduction and multiplication and state how these variants may be identified
- 18b. Give a summary of the variety's distinctness. Clearly state how this application variety may be distinguished from all other varieties in the same crop. If the new variety is most similar to one variety or a group of related varieties:
- (1) identify these varieties and state all differences objectively;
  - (2) attach statistical data for characters expressed numerically and demonstrate that these are clear differences; and
  - (3) submit, if helpful, seed and plant specimens or photographs (prints) of seed and plant comparisons which clearly indicate distinctness.
- 18c. Exhibit C forms are available from the PVPO Office for most crops; specify crop kind. Fill in Exhibit C (Objective Description of Variety) form as completely as possible to describe your variety.
- 18d. Optional additional characteristics and/or photographs. Describe any additional characteristics that cannot be accurately conveyed in Exhibit C. Use comparative varieties as is necessary to reveal more accurately the characteristics that are difficult to describe, such as plant habit, plant color, disease resistance, etc.
- 18e. Section 52(5) of the Act requires applicants to furnish a statement of the basis of the applicant's ownership. An Exhibit E form is available from the PVPO.
19. If "Yes" is specified (*seed of this variety be sold by variety name only, as a class of certified seed*), the applicant **MAY NOT** reverse this affirmative decision after the variety has been sold and so labeled, the decision published, or the certificate issued. However, if "No" has been specified, the applicant may change the choice. (See *Regulations and Rules of Practice, Section 97.103*).
22. See Sections 41, 42, and 43 of the Act and Section 97.5 of the regulations for eligibility requirements.
23. See Section 55 of the Act for instructions on claiming the benefit of an earlier filing date.

**21. CONTINUED FROM FRONT** (Please provide a statement as to the limitation and sequence of generations that may be certified.) Syn-1 generation seed produced from fields planted to approximately equal amounts of Foundation propagules (sprigs) of the six clonal parents may be classified as Registered or downgraded to the Certified class. Registered class seed is for the specific purpose of establishing Certified sod production and will be by written agreement between the owner and the licensee(s). Certified class seed will be the seed of regular commerce.

**22. CONTINUED FROM FRONT** (Please provide the date of first sale, disposition, transfer, or use for each country and the circumstances, if the variety (including any harvested material) or a hybrid produced from this variety has been sold, disposed of, transferred, or used in the U.S. or other countries.)

Johnston Seed Co., Enid, OK 74701 sold a small amount of seed to a golf course, July 25, 2000, for the purpose of a trial planting by the golf course.

**23. CONTINUED FROM FRONT** (Please give the country, date of filing or issuance, and assigned reference number, if the variety or any component of the variety is protected by intellectual property right (Plant Breeder's Right or Patent).)

**NOTES:** It is the responsibility of the applicant/owner to keep the PVPO informed of any changes of address or change of ownership or assignment or owner's representative during the life of the application/certificate. There is no charge for filing a change of address. The fee for filing a change of ownership or assignment or any modification of owner's name is specified in Section 97.175 of the regulations. (See Section 101 of the Act, and Sections 97.130, 97.131, 97.175(h) of the Regulations and Rules of Practice.)

To avoid conflict with other variety names in use, the applicant must check the appropriate recognized authority. For example, for agricultural and vegetable crops, contact: Seed Branch, AMS, USDA, Room 213, Building 306, Beltsville Agricultural Research Center-East, Beltsville, MD 20705. Telephone: (301) 504-8089. <http://www.ams.usda.gov/lsg/seed/lsg-sd.htm>

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this collection of information is (0581-0055). The time required to complete this information collection is estimated to average 1.4 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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S&T-470 (04-01) designed by the Plant Variety Protection Office with WordPerfect 8.0a. Replaces STD-470 (02-99) which is obsolete.

18a. Exhibit A. Origin and Breeding History of the Variety.

'Yukon', *Cynodon dactylon* var. *dactylon*, is a synthetic variety produced by the intercrossing of six clonal parent plants. It was tested under the experimental designation OKS 91-11. The parent plants (18-10, 24-6, 43-10, 44-10, 49-5, and 49-10) were initially selected in 1989 from a broad genetic base breeding population growing on the Oklahoma State University Agronomy Research Station, Stillwater, Oklahoma (36° 5' N latitude, 97° 5' W longitude). The breeding population had been developed in the early 1980's at Stillwater, Oklahoma from winter hardy *Cynodon dactylon* germplasm accessions and breeding lines identified as having seed production capability. Prior to the selection of the parent plants of Yukon, the population had been subjected to two cycles of phenotypic recurrent selection for increased fertility (percentage of florets setting seed), desirable turf characteristics (refined texture e.g. smaller leaves and stems), and good winter hardiness at Stillwater, Oklahoma.

The six Yukon parent plants were selected on the basis of their cross-pollinated fertility (seed production potential), strong self-sterility, growth form (turf type), and winter hardiness. Clonal plants of each of the six parent lines were planted in an isolated polycross block in summer of 1990 on the Agronomy Research Station near El Reno, Oklahoma. First generation (Syn-1) seed produced from this polycross block in 1990 and 1991 was used to initiate testing of the variety, including its entry into the National Turf Evaluation Program bermudagrass test established in 1992. In 1995, the six parent plants were respectively clonally planted for increase on the Agronomy Research Station, Stillwater, Oklahoma. A larger isolated crossing block was also established on the Agronomy Research Station, Stillwater, OK, to provide additional seed for testing.

The six clonal parent plants are non-inbred and therefore genetically heterozygous. Strong self-incompatibility ( $\leq 3\%$  seed set upon self-pollination) of the parent plants ensures seed of predominantly hybrid origin. When randomly inter-mated, the parent plants produce a morphologically heterogeneous offspring population containing 5% or less variant plant types ranging from relatively fine-textured to more robust coarser types. The population is also heterogeneous for fertility. Much less variation exists within the population for freeze tolerance, with most plants exhibiting strong tolerance. The extent (range) of variation for important descriptive characters is addressed in Exhibit B.

The cultivar is uniform and stable within the defined limits of natural genetic variation existing within the Syn-1 generation. Only the Syn-1 seed generation is allowed. Syn-1 generation seed is produced from fields planted to approximately equal quantities of Foundation clonal propagules (sprigs) of the six parent plants. The Syn-1 generation seed may be classified as Registered or downgraded to the Certified class. Registered class seed can be used only for the specific purpose of establishing sod production plantings of the variety. Certified seed will be the seed of regular commerce. No other commercial variety has been developed to date from the breeding population from which Yukon was derived.

No other commercial variety has been developed to date from the breeding population from which Yukon was derived.

18b. Exhibit B. Statement of Distinctness.

'Yukon' is distinct from the most similar existing seed-propagated bermudagrass cultivars (Mirage and Jackpot) in its substantially greater freeze tolerance, growth habit (turf quality), spring dead spot disease resistance, or combinations thereof (Tables 1, 2 and 3). Laboratory measures of freeze tolerance (Table 1) indicated it to have a  $T_{mid}$  (midpoint of the survival-temperature response curve) value of  $-7.6^{\circ}\text{C}$ , statistically greater than Mirage ( $T_{mid} = -6.1^{\circ}\text{C}$ ), but not statistically different from Jackpot ( $-6.3^{\circ}\text{C}$ ). Yukon has demonstrated generally statistically greater resistance to spring dead spot disease caused by *Ophiosphaerella herpotricha* (Fr.) Walker (Table 2) than Mirage and Jackpot. Yukon has generally earlier greenup and higher visual quality ratings than Mirage and Jackpot (Table 3). Comparisons of Yukon with Mirage and Jackpot for several morphological characters are summarized in Tables 4 through 26. These comparisons indicate:

1. Mean stolon internode diameter of Yukon (1.35 mm) is not statistically different from Mirage (1.38mm) or Jackpot (1.19 mm) (Table 4).
2. Mean stolon internode length of Yukon (31.55 mm) is slightly longer than that of Jackpot (27.86 mm) and shorter than that of Mirage (39.65 mm) (Table 5).
3. Mean number of growing points at the 4<sup>th</sup> node from stolon apex is less for Yukon (1.16) than for Mirage (1.37). Yukon and Jackpot do not differ statistically for this trait (Table 6).
4. The mean stolon length of Yukon (146.3 mm) is shorter than that of Mirage (187.9 mm) and statistically not different that that of Jackpot (145.9 mm) (Table 7).
5. Mean leaf blade color ratings using a scale of 1 (light green) to 9 (dark green) indicates Yukon (7.4) to have darker green color than either Mirage (6.5) or Jackpot (6.4) (Table 8).
6. Mean leaf blade width of Yukon (2.36 mm) is wider than that of Mirage (2.07 mm) or Jackpot (1.56 mm) (Table 9).
7. Mean leaf length of Yukon (47.1 mm) does not differ statistically from that of Mirage (49.4 mm) and Jackpot (43.7 mm) (Table 10).
8. Mean flag leaf width of Yukon (1.33 mm) is wider than that of Mirage (1.14 mm) and Jackpot (0.99 mm) (Table 11).

9. Mean flag leaf length of Yukon (20.3 mm) does not statistically differ from that of Jackpot (23.1 mm), but is shorter than that of Mirage (24.9 mm) (Table 12).
10. Mean lateral leaf width of Yukon (2.02 mm) is less than that of Mirage (2.59 mm) and Jackpot (2.55 mm) (Table 13).
11. Mean lateral leaf length of Yukon (34.0 mm) is statistically not different from that of Mirage (31.6 mm) and longer than that of Jackpot (25.3 mm) (Table 14).
12. Mean ratings of leaf hair density do not differ statistically for Yukon (1.4), Mirage (1.3), and Jackpot (1.3) (Table 15).
13. Mean inflorescence lengths of Yukon (43.8 mm), Mirage (44.8 mm), and Jackpot (43.6 mm) are not statistically different (Table 16).
14. Mean number of racemes per inflorescence for Yukon (5.4) is greater than that of Mirage (5.0) and Jackpot (5.0) (Table 17).
15. Mean number of raceme whorls per inflorescence of Yukon (1.06) is greater than that of Mirage (1.02) and Jackpot (1.00) (Table 18).
16. Mean number of spikelets per raceme for Yukon (35.4) is less than that of Mirage (41.3) and Jackpot (42.3) (Table 19).
17. Yukon has a higher percentage of plants with white stigmas (75%) than Mirage (10%) and Jackpot (50%) (Table 20). Yukon has a lower percentage of plants with light purple stigmas (10%) than Mirage (20%) and Jackpot (30%) (Table 20). Yukon has a lower percentage of plants with purple stigmas (15%) than Mirage (70%) and Jackpot (20%) (Table 20). Yukon has a higher percentage of plants with yellow anthers (90%) and a lower percentage of plants with purple anthers (10%) than Mirage (65% yellow; 35% purple) and Jackpot (100% yellow) (Table 20).
18. Mean head exertion length of Yukon (14.6 mm) is shorter than that of Mirage (26.3 mm) and Jackpot (33.3 mm) (Table 21).
19. Mean peduncle length of Yukon (69.7 mm) is shorter than that of Mirage (91.4 mm) and Jackpot (93.2 mm) (Table 22).
20. Mean 1<sup>st</sup> internode length of seed stalks of Yukon (37.0 mm) is shorter than that of Mirage (50.7 mm) and Jackpot (50.8 mm) (Table 23).

21. Mean flag leaf sheath length of Yukon (54.1 mm) is shorter than that of Mirage (64.8 mm) and Jackpot (60.8 mm) (Table 24).
22. Mean plant height of Yukon (411.1 mm) is shorter than that of Mirage (551.2 mm) and not statistically different than that of Jackpot (422.3 mm) (Table 25).
23. Mean mature vegetative height of Yukon (292.1 mm) is shorter than that of Mirage (348.0 mm) and not statistically different from that of Jackpot (297.2 mm) (Table 26).

Table 8. Mean leaf blade color ratings for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. † Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Leaf Blade Color Ratings				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- Rating -----				
Guymon	7.9	8.0	7.7	7-9	7-9
Yukon	7.3	7.5	7.4	6-9	6-9
Mirage	6.6	6.4	6.5	6-9	5-9
Jackpot	6.3	6.5	6.4	6-7	6-7
Arizona Common	6.2	6.4	6.3	5-7	6-7
NuMex Sahara	5.6	5.6	5.6	3-7	5-7
5% LSD	0.5	0.6	0.5	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\* Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 9. Mean leaf width for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. † Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Leaf Width				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	-----mm-----				
Guymon	3.2	3.4	3.3	2.0-5.3	2.1-5.2
Yukon	2.4	2.4	2.4	1.3-3.1	1.5-3.3
Mirage	2.0	2.2	2.1	1.3-2.9	1.5-2.9
Arizona Common	1.8	2.0	1.9	1.3-2.5	1.4-2.5
NuMex Sahara	1.9	1.7	1.8	1.4-2.4	1.3-2.5
Jackpot	1.5	1.7	1.6	1.0-2.8	1.1-2.7
5% LSD	0.3	0.2	0.2	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\* Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 18. Mean number of raceme whorls per inflorescence for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. † Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Raceme Whorls/Inflorescence				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	-----No -----				
Yukon	1.1	1.1	1.1	1-2	1-2
Guymon	1.0	1.0	1.0	1-2	1-2
Arizona Common	1.0	1.0	1.0	1-2	1-2
Mirage	1.0	1.0	1.0	1-2	1-2
Jackpot	1.0	1.0	1.0	1-1	1-1
NuMex Sahara	1.0	1.0	1.0	1-1	1-1
5% LSD	0.05	0.05	0.03	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\* Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 19. Mean number of spikelets per raceme for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000.

† Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem.

Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Spikelets/Raceme				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	-----No -----				
Guymon	50.9	52.3	51.6	24-72	27-74
NuMex Sahara	42.8	43.6	43.2	20-65	20-63
Jackpot	41.6	43.0	42.3	19-63	17-62
Mirage	41.5	41.1	41.3	16-67	16-63
Arizona Common	39.6	38.4	39.0	26-62	24-63
Yukon	34.2	36.6	35.4	14-56	14-53
5% LSD	2.6	2.5	2.2	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\* Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

REPRODUCE LOCALLY. Include form number and date on all reproductions.

Form Approved - OMB No. 0581-0055

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U. S. DEPARTMENT OF AGRICULTURE  
AGRICULTURAL MARKETING SERVICE  
SCIENCE AND TECHNOLOGY  
PLANT VARIETY PROTECTION OFFICE  
BELTSVILLE, MD 20705

EXHIBIT C  
(Bermudagrass)

OBJECTIVE DESCRIPTION OF VARIETY  
BERMUDAGRASS (*Cynodon* spp.)

NAME OF APPLICANT(S) Oklahoma Agricultural Experiment Station	FOR OFFICIAL USE ONLY PVPO NUMBER <b>200100234</b>
ADDRESS (Street and No. or R.F.D. No., City, State, and ZIP Code) 139 Agricultural Hall Stillwater, OK 74078-6019	VARIETY NAME Yukon
	TEMPORARY OR EXPERIMENTAL DESIGNATION OKS '91-11

Place the appropriate number that describes the varietal character of this variety in the spaces provided. Place a zero in the first box (e.g. 0/9/9 or 0/9/) when number is either 99 or less or 9 or less. The symbol "▲" indicates decimal. Characteristics described, including numerical measurements, should represent those that are TYPICAL for the variety. Comparisons to standard varieties must be made under the same conditions. Append all pertinent comparative trial and evaluation data. Measured data should be for unclipped spaced plants that represent the application variety, the most similar variety, and one standard cultivar, or replicated unclipped plots or individual unclipped pots if grown in a greenhouse. Data should be obtained from mature plants (specify age of plants when measured). A minimum of 30 plants and 60 data points should be used for all measurements. Specify growing conditions and experimental design. Give location of test area.

STANDARD CULTIVARS Use cultivars from same species and ploidy level

- |                   |              |                  |                                  |
|-------------------|--------------|------------------|----------------------------------|
| 1 = Seeded Common | 4 = Tifway   | 7 = Coastal      | 10 = other (Specify species)     |
| 2 = Guymon        | 5 = Tifgreen | 8 = Coastcross-1 |                                  |
| 3 = Mirage        | 6 = Midiron  | 9 = Giant        | Jackpot, <i>Cynodon dactylon</i> |

SPECIFIC VARIETIES USED FOR COMPARISON AS CHECK VARIETIES IN THIS APPLICATION: Use standard regional check varieties that are adapted to your area. One of the comparison varieties must be the most similar variety (MSV) used in Exhibit B.

MSV 1. Mirage Variety 2. Jackpot Variety 3. \_\_\_\_\_

1. SPECIES: (With comparison varieties for use below - use varieties within species of application variety)

**1**

- 1 = *C. dactylon* var. *dactylon*  
2 = *C. dactylon* var. *aridus*  
3 = *C. transvaalensis*  
4 = *C. dactylon* X *C. transvaalensis*  
5 = Other (Specify). \_\_\_\_\_

Is this an F<sub>1</sub> hybrid? No  
Is this for turf or forage use? Turf  
Is this seed or clonally propagated? Seed

2. CYTOLOGY

**3** **6** 2n Chromosome Number

**Ploidy**

1 = diploid

2 = tetraploid

3 = triploid

4 = Other (Specify)

200100234

Application Variety

MSV Variety 1

Comparison Variety 2

Comparison Variety 3

222**3. ADAPTATION:** ( 0= Not tested; 1= Inadequately Tested; 2= Not Adapted; 3 = Adapted)

1
3
3

Northwest  
West Central  
Southwest

1
3
3

North Central  
Central  
South Central

1
3
3

Northeast  
East Central  
Southeast

1
3
3

Other  
Other  
Other

**4. RHIZOMES**

1 = None (Coastcross -1)

4 = Weakly Rhizomatous (Coastal)

6 = Moderately Rhizomatous (Common)

9 = Heavy Rhizomatous

999

Amount of spread in 1 year cm

609090**5. STOLONS AND SHOOTS:**Specify site, season and growing conditions: Stillwater, OK; Cool growing conditions in fall.Anthocyanin pigmentation (cool temperature). Examples: **present** in Common, **absent** in Midland.

or

Percent of plants with anthocyanin pigmentation

60Stolon internode length cm. Measure from between 3<sup>rd</sup> and 4<sup>th</sup> fully extended nodes from apical meristem.3.163.972.79Stolon internode diameter mm. Measure from center of 3<sup>rd</sup> fully extended internode from apical meristem.1.351.381.19Number of growing points at a mature node. Recommend 4<sup>th</sup> node.1.161.371.18

Specify which node was counted.

4th4th4th

Length of longest stolon cm

36.342.527.0

**Stolon length mm.** Measure from the stolon apical meristem to the 5<sup>th</sup> node of the central stolon.

200100234

Application Variety	MSV Variety 1	Comparison Variety 2	Comparison Variety 3
146	188	146	

## 6. LEAF BLADE:

### Color

- 1 = Light Green (Bayshore, Seeded Common),  
 3 = Light Medium Green,  
 5 = Medium Green (Guymon),  
 7 = Medium Dark Green (Everglades, Tifway),  
 9 = Dark Green (Tifgreen, Sunturf),

7	5	5	
---	---	---	--

### Other Color

- 1 = Bluegreen (Tifdwarf, No Mow)  
 2 = Grey Green  
 3 = Other (specify)

9	9	7	
---	---	---	--

### Percent plants with other color

5	2	5	
---	---	---	--

### Width Class

- 1 = Very Coarse (Coastcross-1)  
 3 = Coarse (Midland, Guymon)  
 5 = Medium (Seeded Common)  
 7 = Fine (Tifway)  
 9 = Very Fine (Tifgreen)

5	5	5	
---	---	---	--

**Leaf length cm.** Measure longest leaf at third node below apical meristem on main upright tiller.

4.71	4.94	4.37	
------	------	------	--

**Leaf width mm.** Measurement on 3<sup>rd</sup> or 4<sup>th</sup> leaf below apical meristem. Measure width at widest part about 1 cm from base.

2.36	2.07	1.56	
------	------	------	--

### Flag leaf length cm

2.03	2.49	2.31	
------	------	------	--

**Flag leaf width mm.** Measure width at widest part or about 1 cm from base.

1.33	1.14	0.99	
------	------	------	--

### Flag leaf sheath length mm

54.1	64.8	60.8	
------	------	------	--

**Leaf width mm (lateral leaves).** Measure the widest part of largest leaf at 4<sup>th</sup> node from tip of stolon.

2.02	2.59	2.55	
------	------	------	--

**Leaf length cm (lateral leaves).** Measure the longest part of largest leaf at 4<sup>th</sup> node from tip of stolon.

3.40	3.16	2.53	
------	------	------	--

Leaf blade hair number (use 1 = absent; several; 9 = abundant).

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Application Variety

MSV Variety 1

Comparison Variety 2

Comparison Variety 3

severalseveralseveral

Leaf blade hair length (use 1 = absent; 5=short; 9 = very long).

555

Leaf sheath hair number (use 1 = absent; several; 9 = abundant).

severalseveralseveral

Leaf sheath hair length (use 1 = absent; 5=short; 9 = very long).

555

Leaf collar hair number (use 1 = absent; several; 9 = abundant).

Leaf collar hair length (use 1 = absent; 5=short; 9 = very long).

## 7. INFLORESCENCE (Specify site, season, and growing conditions).

Inflorescence length cm. The length of the racemes on the inflorescence.

Application Variety

MSV Variety 1

Comparison Variety 2

Comparison Variety 3

4.384.484.36

Number of racemes per inflorescence.

5.45.05.0

Number of whorls per inflorescence.

1.061.021.00

Percent of plants with more than one whorl of branches/inflorescence.

000

Percent of inflorescences with more than 1 whorl.

< 1< 10

Spikelets per raceme.

35.441.342.3

Spikelet spacing on raceme mm Measured from bottom 1/3 of spike.

Raceme density [number of racemes/ (0.2m)<sup>2</sup>]

200 100 234

Application Variety

MSV Variety 1

Comparison Variety 2

Comparison Variety 3

Percent of plants with spike anthocyanin

Stigma color % plants with white stigmas. Measure within 24 hours after anthesis.

75

10

50

Stigma color % plants with light purple stigmas. Measure within 24 hours after anthesis.

10

20

30

Stigma color % plants with purple stigmas. Measure within 24 hours after anthesis.

15

70

20

Anther color % plants with purple anthers. Measure within 24 hours after anthesis.

10

35

10

Anther color % plants with yellow anthers. Measure within 24 hours after anthesis.

90

65

100

Anther color % plants with other (specify). Measure within 24 hours after anthesis.

Head exertion cm. Measure from the base of the inflorescence to the flag leaf.

1.46

2.63

3.33

Peduncle length cm. Measure internode from base of whorl to first node.

6.97

9.14

9.32

First internode length cm.

3.70

5.07

5.08

Flag leaf sheath length cm. Measure from node to flag leaf base.

5.41

6.48

6.08

## 8. PLANT HEIGHT (Specify site, time, growing conditions).

Plant height cm. Measure at maturity, using the tallest inflorescence per plant and hold out to furthest extension for measurement.

41.11

55.12

42.23

Vegetative height cm. Height of vegetation excluding seedheads, measure at seedhead maturity.

29.21

34.80

29.72

9. SEED, LEMMA, AND GLUME: Use seed harvested from PVP nursery, not commercial seed lots.

200100234

	Application Variety	MSV Variety 1	Comparison Variety 2	Comparison Variety 3
Glume length mm	17			
Glume width mm	4			
Lemma length mm	24			
Lemma width mm	2.5			
Glume/lemma length ratio	0.71			
Lemma keel hair number (use 1 = absent; 5=several; 9 = many).	9			
Lemma keel hair length (use 1 = absent; 5=short; 9 = very long).	5			
Lemma margin hair number (use 1 = absent; 5=several; 9 = many).	5			
Lemma margin hair length (use 1 = absent; 5=short; 9 = very long).	5			
Seed length mm (naked caryopses).	14			
Seed width mm (naked caryopses).	7			
Explain if samples are blown and unhulled or hulled.	unhulled, blown			
Weight of 100 seed mg	28			
Number of seeds per gram	3640			

## 10. LOW TEMPERATURE TOLERANCE (Winter hardiness)

200 100 234

- 1 = Low or 100% injury (Coastcross-1, Common)  
 4 = Moderately Low (Coastal, Brazos)  
 6 = Moderately High (Tifway, Guymon, Tifdwarf)  
 9 = High or no injury (Midiron, Midland)

Application Variety	MSV Variety 1	Comparison Variety 2	Comparison Variety 3
9	6	6	

## 11. DISEASES AND INSECTS

(0=Not Tested, 1=Susceptible, 2=Moderately susceptible, 3=Moderately resistant, 4=Resistant):

0	Brown patch ( <i>Rhizotonia solani</i> )	0	Aphids
0	Dollar spot ( <i>Sclerotinia homoeocarpa</i> )	2	Bermudagrass mite ( <i>Eriophyes cynodontiensis</i> )
0	Fading out ( <i>Curvularia spp.</i> )	0	Chinch bugs
3	Leafspot ( <i>Bipolaris spp.</i> )	0	Ground pearl (scale)
0	Rusts ( <i>Puccinia spp.</i> )	0	Grubs
2	Spring Dead Spot ( <i>Pathogen indefinite</i> )	0	Thrips
0	Zonate leafspot ( <i>D. gigantea</i> )	0	Whitefly
	Other: _____		Other: _____

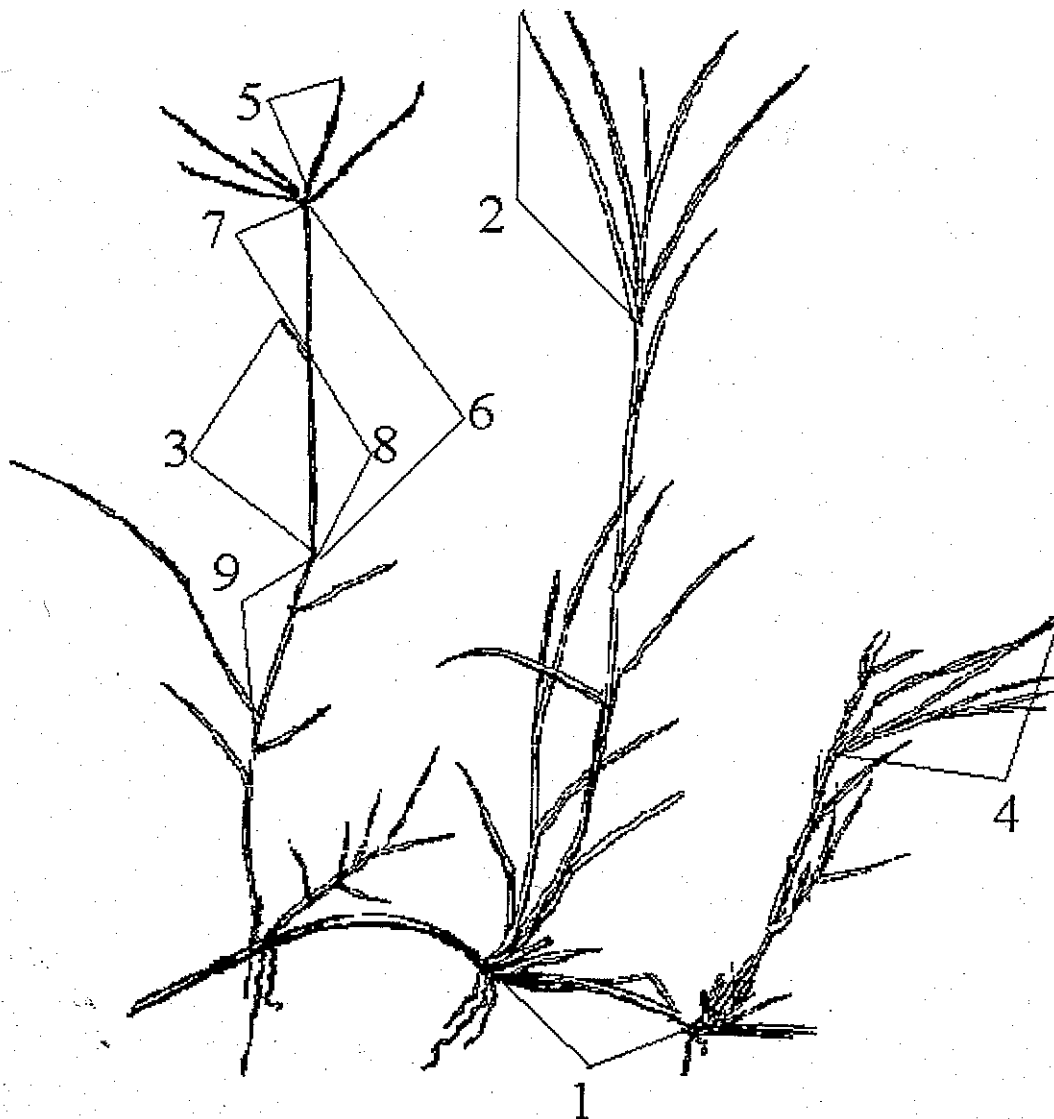
## 12. INDICATE THE SEED PROPAGATED VARIETY THAT MOST CLOSELY RESEMBLES THE APPLICATION VARIETY FOR THE FOLLOWING CHARACTERS: For each of the following characters, indicate the degree of resemblance by placing in the column marked "D.R." one of the following numbers.

- 1 = Application variety is less than comparison variety.  
 2 = Same as.  
 3 = More than, better, greater, darker, etc.

CHARACTER	VARIETY	D.R.
Rate of Spread	Mirage	1
Sod Density	Mirage	3
Color	Guymon	2
Cold Tolerance	Guymon	2

## 13. SPECIFY LOCATION, GROWING CONDITIONS, AND EXPERIMENTAL DESIGN BELOW. Include location, age of plants, date of data collection (with daylength if possible), management conditions, experimental design etc.). Attach more paper if needed.

Agronomy Research Station, Oklahoma State University, Stillwater, OK.  
 Plants planted Summer, 1998. Data taken Summers of 1999 & 2000. Good growth environment provided i.e. well fertilized and irrigated as needed.  
 Plants arranged in a randomized complete block design with split plots and four reps. Whole plots were varieties and subplots were individual plants within varieties. Measurements were taken on 60 plants/variety i.e. 15 plants/variety/rep. Measurements taken on mature plants during the period from late June to August. Individual plants were maintained in approximately 6x6 feet plots by spraying 4x4 feet alleys with Roundup herbicide as needed.



Bermuda grass (*Cynodon dactylon*)

1. Stolon internode length
2. First fully extended leaf of upright growth
3. Flag leaf length
4. First fully extended leaf from tip of stolon
5. Inflorescence length
6. Peduncle length
7. Head exertion
8. Sheath length
9. First internode length

#### REFERENCE

Parker, Kittie F., An Illustrated Guide to Arizona Weeds. Drawings by Lucretia Breazeale Hamilton. Tucson, University of Arizona Press [1972]. xii, 338 p. illus.

18d. Exhibit D. Additional description of variety.

'Yukon' differs from selected seed-propagated turf bermudagrass varieties other than the two most similar varieties (Mirage and Jackpot) as follows (see Table references in Exhibit B):

1. Yukon has greater freezer tolerance than Arizona Common (Table 1).
2. Yukon has generally earlier greenup and higher turf quality ratings than Arizona Common, Blackjack, Blue Muda, Majestic, NuMex Sahara, Pyramid, Savannah, and Sundevil II seeded bermudagrass varieties (Table 3).
3. Mean stolon internode diameter of Yukon (1.35 mm) is shorter than that of Guymon (2.04) (Table 4).
4. Mean stolon internode length of Yukon (31.55 mm) is shorter than that of Arizona Common (46.70 mm) and NuMex Sahara (43.99 mm) (Table 5).
5. Mean number of growing points at the 4<sup>th</sup> node from stolon apex is less for Yukon (1.16) than for NuMex Sahara (1.32 mm) and Arizona Common (1.21 mm) (Table 6).
6. The mean stolon length of Yukon (146.3 mm) is shorter than that of Arizona Common (215.6 mm), NuMex Sahara (206.2), and Guymon (171.1) (Table 7).
7. Mean leaf blade color ratings using a scale of 1 (light green) to 9 (dark green) indicates Yukon (7.4) to have darker green color than Arizona Common 96.3) and NuMex Sahara (5.6) (Table 8).
8. Mean leaf blade width of Yukon (2.36 mm) is narrower than that of Guymon (3.29 mm), and wider than that of Arizona Common (1.87 mm) and NuMex Sahara (1.76 mm) (Table 9).
9. Mean leaf length of Yukon (47.1 mm) is shorter than that of Guymon (76.9 mm), NuMex Sahara (60.4 mm), and Arizona Common (52.2 mm) (Table 10).
10. Mean flag leaf width of Yukon (1.33 mm) is less than that of Guymon (1.74 mm) and wider than that of Arizona Common (1.15 mm) and NuMex Sahara (1.05 mm) (Table 11).
11. Mean flag leaf length of Yukon (20.3 mm) is shorter than that of Guymon (40.5 mm), NuMex Sahara (30.2 mm), and Arizona Common (26.7 mm) (Table 12).
12. Mean lateral leaf width of Yukon (2.02 mm) is less than that of NuMex Sahara (2.68 mm), Arizona Common (2.63 mm), and Guymon (2.56 mm) (Table 13).
13. Mean lateral leaf length of Yukon (34.0 mm) is longer than that of Guymon (25.6 mm) (Table 14).

14. Mean ratings of leaf hair density for Yukon (1.4) are less than for Guymon (5.9) (Table 15).
15. Mean inflorescence length of Yukon (43.8 mm) is shorter than that of Guymon (60.7) and NuMex Sahara (48.6 mm) (Table 16).
16. Mean number of racemes per inflorescence for Yukon (5.4) is less than that for Guymon (5.7) and greater than that of NuMex Sahara (5.1) and Arizona Common (5.0) (Table 17).
17. Mean number of raceme whorls per inflorescence of Yukon (1.06) is greater than that of NuMex Sahara (1.0) (Table 18).
18. Mean number of spikelets per raceme for Yukon (35.4) is less than that of Guymon (51.6 mm), NuMex Sahara (43.2 mm), and Arizona Common (39.0 mm) (Table 19).
19. Yukon has a higher percentage of plants with white stigmas (75%) and lower percentages of plants with light purple (10) or purple (15) stigmas than Guymon (10, 20, 70), NuMex Sahara (40, 35, 25), and Arizona Common (15, 35, 50) (Table 20). Yukon has a higher percentage of plants with yellow anthers (90%) and a lower percentage of plants with purple anthers (10%) than Guymon (75, 25), NuMex Sahara (65, 35), and Arizona Common (15, 85) (Table 20).
20. Mean head exertion length of Yukon (14.6 mm) is shorter than that of Guymon (39.4 mm), NuMex Sahara (24.9 mm), and Arizona Common (22.3 mm) (Table 21).
21. Mean peduncle length of Yukon (69.7 mm) is shorter than that of Guymon (133.5 mm), NuMex Sahara (99.2 mm), and Arizona Common (86.3 mm) (Table 22).
22. Mean 1<sup>st</sup> internode length of seed stalks of Yukon (37.0 mm) is shorter than that of Guymon (97.0 mm), NuMex Sahara (57.4 mm), and Arizona Common (42.1 mm) (Table 23).
23. Mean flag leaf sheath length of Yukon (54.1 mm) is shorter than that of Guymon (97.0 mm), NuMex Sahara (73.9 mm), and Arizona Common (63.8 mm) (Table 24).
24. Mean mature plant height of Yukon (411.1 mm) is shorter than that of Guymon (638.8 mm), Arizona Common (604.5 mm), and NuMex Sahara (564.5 mm) (Table 25).
25. Mean mature vegetative height of Yukon (292.1 mm) is shorter than that of Guymon (414.0 mm), NuMex Sahara (363.2 mm), and Arizona Common (340.4 mm) (Table 26).
26. DNA profiling easily differentiated Yukon from the following seeded varieties: Mirage, Jackpot, Arizona Common, CD90160, Mohawk, Savannah, Southern Star, Sundevil, NuMex Sahara, Sydney, Pyramid, Transcontinental, Majestic, Riviera, Princess, and SWI-11 (See attached manuscript entitled 'DNA Fingerprinting of Seeded Bermudagrass

Cultivars' by Praveen Nagh Yerramsetty, Michael P. Anderson, Charles M. Taliaferro and Dennis L. Martin. The manuscript has been accepted for publication in Crop Science and is in press as of September 2004).

Table 1. Freeze tolerance of fairway, seeded, and putting green bermudagrasses.  $T_{mid}$  values represent the midpoint of the survival-temperature response curve<sup>†</sup>.

Fairway		Seeded		Putting Green	
Genotype	$T_{mid}$ (°C)	Genotype	$T_{mid}$ (°C)	Genotype	$T_{mid}$ (°C)
GN-1	-5.8a*	AZ Common	-5.6 a*	Champion	-4.8 a*
Baby	-6.1ab	Mirage	-6.1 ab	Floradwarf	-4.9 a
Tifway	-6.6ab	Jackpot	-6.3 abc	MS-Supreme	-5.2 ab
Tifsport	-7.4bc	Guymon	-7.4 bc	Mini-verde	-5.8 bc
Quickstand	-8.0cd	Yukon	-7.6 c	Tifeagle	-6.0 cd
Midlawn	-8.4d			Tifdwarf	-6.5 d
				Tifgreen	-6.5 d

<sup>†</sup> Data are from the publication: Anderson, Jeff, Charles Taliaferro, and Dennis Martin. 2002. Freeze tolerance of bermudagrasses: vegetatively propagated cultivars intended for fairway and putting green use, and seed-propagated cultivars. *Crop Sci.* 42:975-977. The research was conducted at the Oklahoma State University, Stillwater, OK during the period February 1999 through March 2000.

\*Means of three repetitions within columns are separated by Duncan's New Multiple Range Test at  $P \leq 0.05$ .

Table 2. Influence of cultivar and mowing height on bermudagrass response to spring dead spot at Stillwater, OK. Plots were inoculated with *Ophiosphaerella herpotricha* in 1996.

Area of spring dead spot necrotic patches†						
Mowing height			Year			
1.3 cm§	3.8 cm	Mean	1997	1998	1999	Shoot survival‡
-----dm <sup>2</sup> -----			-----dm <sup>2</sup> -----			-----%
Mirage	12.6a	12.0b	12.3b	1.3a	9.9ab	25.7a
Yukon	6.7b	9.3b	8.0c	0.5b	8.9b	14.7b
Jackpot	11.6a	17.4a	14.5a	1.3a	13.6a	28.7a
Mean¶	10.3y	12.9x	1.0z	10.8y	23.0x	1.6y
						0.2y
						4.1x
						0.7b
						4.3a
						1.0b

†Area is the average area in dm<sup>2</sup> of three necrotic patches in each subplot.

‡Percent shoot survival was calculated by expressing plant survival counts per unit area in necrotic patches as a percentage of plant counts per unit area in unaffected turf.

§Where labeled, means in a column are significantly different at P=0.05 (LSD).

¶Means in a row followed by a different letter (x,y or z) are significantly different at P=0.05 (LSD).

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Table 3. Visual quality, and percent divot recovery ratings for the 1997 NTEP Bermudagrass Trial at Stillwater, Oklahoma in 2000.

Entry	Spring Greenup Ratings <sup>1</sup>	Visual Quality Ratings <sup>2</sup>				
	5 April	15 May	15 June	17 July	16 Aug	18 Sept
AZ Common	2.6	4.6	5.6	5.6	6.0	6.3
Blackjack	2.6	5.3	5.6	6.0	6.0	6.6
Blue Muda	2.6	4.6	6.0	5.6	6.0	6.6
Cardinal	6.6	5.0	5.6	4.6	5.3	4.0
CN2-9	2.6	7.3	8.0	7.6	7.3	8.0
GN-1	2.3	6.0	6.6	7.0	7.3	7.3
J-1224	2.3	4.6	5.6	5.6	6.0	6.6
J-540	2.3	5.0	5.6	5.3	6.0	6.6
Jackpot	3.0	4.6	5.3	5.6	6.0	6.3
Majestic	2.3	4.6	5.6	6.0	6.0	6.6
Midlawn	5.3	7.3	7.6	7.3	7.6	8.0
Mini-verde	2.0	5.0	6.0	4.6	5.0	5.3
Mirage	3.0	5.3	6.0	5.6	6.3	6.6
Numex Sahara	3.6	5.0	5.6	6.0	6.0	6.6
OKC 18-4	2.3	7.6	8.3	7.3	6.6	7.3
OKC 19-9	2.6	7.3	8.3	7.6	7.3	8.0
Yukon	3.6	7.0	7.3	7.3	6.6	7.6
OKS 95-1	3.6	6.6	7.3	7.6	7.3	7.6
Princess	1.3	4.6	6.0	6.3	7.3	7.6
PST-R69C	2.6	5.3	6.6	6.3	7.0	7.0
Pyramid	1.6	4.0	5.3	5.6	6.0	6.6
Savannah	2.6	4.6	5.6	6.0	6.6	6.6
Shanghai	2.0	5.0	6.3	6.3	5.6	6.3
Shangri-La	3.0	5.0	6.0	5.6	6.3	6.3
Sundevil II	3.3	5.0	5.6	5.6	6.3	6.6
SW1-11	1.6	5.0	6.0	6.0	6.6	6.3
SW1-7	3.0	4.6	5.6	6.0	6.6	6.6
Tifgreen	4.3	7.3	8.0	7.3	8.0	8.0
Tifsport	2.6	7.6	8.0	7.6	8.0	8.0
Tifway	2.0	7.6	8.3	7.6	8.0	8.0
LSD(p=0.05)	1.1	0.8	0.8	0.9	0.8	0.6

<sup>1</sup> Spring greenup was rated on a 1-9 scale (1=completely dormant, 9=completely green).

<sup>2</sup> Visual quality was rated on a 1-9 scale (1=poor quality, 9=high quality).

Table 4. Mean internode diameter for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. † Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Stolon Internode Diameter				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- mm -----				
Guymon	1.99	2.09	2.04	1.0-2.5	1.1-2.6
Mirage	1.41	1.35	1.38	1.0-2.3	1.1-2.0
Yukon	1.40	1.30	1.35	0.8-1.7	0.9-2.0
Arizona Common	1.31	1.35	1.33	0.8-1.9	0.9-2.0
NuMex Sahara	1.23	1.33	1.28	0.9-1.8	0.8-1.7
Jackpot	1.24	1.14	1.19	0.8-1.6	0.8-1.8
5% LSD	0.35	0.28	0.36	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\* Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 5. Mean stolon internode length for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. † Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Stolon Internode Length				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- mm -----				
Arizona Common	43.80	49.60	46.70	12.5-148.0	14.5-159.0
NuMex Sahara	41.52	46.46	43.99	14.5-89.0	13.0-85.0
Mirage	41.36	37.94	39.65	10.0-114.2	12.0-109.0
Guymon	33.74	36.16	34.95	8.0-123.0	9.0-125.2
Yukon	33.23	29.87	31.55	8.2-97.5	10.0-104.5
Jackpot	29.38	26.34	27.86	8.3-73.0	6.2-70.8
5% LSD	3.59	3.63	3.65	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\* Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 6. Mean number of growing points emanating from the 4<sup>th</sup> node of mature stolons based on five measurements from each of 60 plants in 1999 and 2000. <sup>†</sup> Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Growing Points/4 <sup>th</sup> Node				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- No -----				
Mirage	1.35	1.39	1.37	1-3	1-3
NuMex Sahara	1.35	1.29	1.32	1-2	1-2
Arizona Common	1.19	1.23	1.21	1-2	1-2
Jackpot	1.19	1.17	1.18	1-2	1-2
Yukon	1.16	1.16	1.16	1-2	1-2
Guymon	1.18	1.00	1.09	1-2	1-2
5% LSD	0.10	0.9	0.10	-	-

<sup>†</sup>Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\*Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 7. Mean stolon length for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. <sup>†</sup> Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Stolon Length				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- mm -----				
Arizona Common	207.4	223.8	215.6	99-575	103-582
NuMex Sahara	198.7	213.7	206.2	108-363	114-360
Mirage	165.8	210.0	187.9	69-410	72-425
Guymon	168.7	173.5	171.1	73-390	75-370
Yukon	139.8	152.8	146.3	65-355	60-363
Jackpot	139.8	152.0	145.9	82-270	85-265
5% LSD	14.9	15.5	16.0	-	-

<sup>†</sup>Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\*Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 10. Mean leaf length for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. † Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Leaf Length				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- mm -----				
Guymon	74.4	79.4	76.9	26.0-213.0	29.0-214.0
NuMex Sahara	58.3	62.5	60.4	17.0-127.0	26.0-135.0
Arizona Common	56.6	47.8	52.2	20.0-125.0	17.0-129.0
Mirage	51.0	47.8	49.4	15.0-110.0	17.0-109.0
Yukon	47.5	46.7	47.1	19.0-74.0	18.0-75.0
Jackpot	44.8	42.6	43.7	12.0-105.0	16.0-109.0
5% LSD	5.1	5.0	5.2	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\* Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 11. Mean flag leaf width for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. † Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Flag Leaf Width				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- mm -----				
Guymon	1.6	1.8	1.7	0.8-3.7	0.9-3.8
Yukon	1.2	1.4	1.3	0.8-1.9	0.9-2.0
Arizona Common	1.2	1.2	1.2	0.8-2.0	0.8-2.0
Mirage	1.0	1.2	1.1	0.5-2.2	0.6-2.3
NuMex Sahara	1.1	1.1	1.1	0.8-1.8	0.8-1.7
Jackpot	0.9	1.1	1.0	0.8-1.9	0.8-2.0
5% LSD	0.2	0.3	0.2	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\* Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 12. Mean flag leaf length for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. † Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Flag Leaf Length				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	-----mm-----				
Guymon	38.4	42.6	40.5	5-139	6-144
NuMex Sahara	27.9	32.5	30.2	5-87	5-90
Arizona Common	24.6	28.8	26.7	5-64	6-65
Mirage	23.8	26.0	24.9	6-92	5-93
Jackpot	22.4	23.8	23.1	4-80	4-79
Yukon	18.6	22.0	20.3	6-60	6-61
5% LSD	3.5	3.6	3.4	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\*Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 13. Mean lateral leaf width for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. † Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Lateral Leaf Width				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	-----mm-----				
NuMex Sahara	2.7	2.7	2.7	1.5-3.8	1.5-3.7
Arizona Common	2.6	2.6	2.6	1.8-3.2	1.8-3.3
Mirage	2.6	2.6	2.6	1.5-3.5	1.6-3.6
Guymon	2.5	2.7	2.6	0.8-5.3	0.9-5.2
Jackpot	2.5	2.7	2.6	1.0-3.8	1.1-3.8
Yukon	2.0	2.0	2.0	0.8-3.7	0.9-3.8
5% LSD	0.4	0.5	0.5	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\*Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 14. Mean lateral leaf length for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. † Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Lateral Leaf Length				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- mm -----				
Yukon	31.7	36.3	34.0	3.0-126.0	7.0-124.0
Arizona Common	32.1	34.7	33.4	17.0-58.0	21.0-59.0
NuMex Sahara	34.0	32.2	33.1	12.0-89.7	9.0-91.2
Mirage	29.7	33.5	31.6	12.0-74.0	12.0-68.0
Guymon	25.9	25.3	25.6	5.0-126.0	7.0-129.0
Jackpot	26.0	24.6	25.3	12.0-60.0	10.0-64.0
5% LSD	4.0	4.1	5.0	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\* Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 15. Mean ratings of leaf hair density for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. † Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Leaf Hair Density Ratings				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- Rating -----				
Guymon	5.7	6.1	5.9	1-9	1-9
Arizona Common	1.4	1.6	1.5	1-3	1-3
Yukon	1.4	1.4	1.4	1-4	1-5
NuMex Sahara	1.5	1.3	1.4	1-2	1-2
Mirage	1.3	1.3	1.3	1-2	1-2
Jackpot	1.2	1.4	1.3	1-3	1-3
5% LSD	1.2	1.1	1.0	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\* Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 16. Mean inflorescence length for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. † Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Inflorescence Length				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- mm -----				
Guymon	63.0	58.4	60.7	29-80	31-84
NuMex Sahara	49.5	47.7	48.6	27-72	25-75
Mirage	44.6	45.0	44.8	25-70	25-69
Yukon	45.9	41.7	43.8	16-65	15-67
Jackpot	44.9	42.3	43.6	20-65	20-63
Arizona Common	44.5	42.1	43.3	24-65	25-70
5% LSD	3.6	3.5	3.7	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\* Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 17. Mean number of racemes per inflorescence for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. † Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Number of Racemes/Inflorescence				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- No -----				
Guymon	5.6	5.8	5.7	3-9	3-9
Yukon	5.3	5.5	5.4	3-9	3-9
NuMex Sahara	5.0	5.2	5.1	4-5	4-6
Jackpot	5.0	5.0	5.0	3-6	3-6
Arizona Common	5.1	4.9	5.0	3-7	3-8
Mirage	5.0	5.0	5.0	4-6	4-7
5% LSD	0.25	0.24	0.25	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\* Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 20. Mean percentage plants based on stigma and anther color for seven seed-propagated turf bermudagrass cultivars based on measurements from five inflorescences from each of 60 plants in 1999 and 2000. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Stigma Color						Anther Color					
	White			Light Purple			Purple			Yellow		
	1999	2000		1999	2000		1999	2000		1999	2000	
	-----% of Plants -----											
Guymon	10	10		19	21		71	69		75	75	
NuMex NuMex Sahara	40	40		33	37		27	23		65	65	
Jackpot	50	50		30	30		20	20		100	100	
Mirage	10	10		19	21		71	69		65	65	
Arizona	15	15		32	38		53	47		15	15	
Common												
Yukon	75	75		9	11		16	14		90	90	

Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plants were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Stigma color is a discrete characteristic that changes little with environment; slight variations in percentages of light purple and purple between years is likely attributable to evaluator differences in distinguishing the two categories.

Table 21. Mean head exertion length for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. <sup>†</sup>Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Head Exsertion Length				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- mm -----				
Guymon	39.2	39.6	39.4	1-107	0-105
Jackpot	32.4	34.2	33.3	0-96	0-94
Mirage	26.8	25.8	26.3	1-84	0-80
NuMex Sahara	23.8	26.0	24.9	0-97	0-90
Arizona Common	21.6	23.0	22.3	0-75	0-78
Yukon	15.3	13.9	14.6	0-63	0-65
5% LSD	5.1	5.1	4.6	-	-

<sup>†</sup>Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\*Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 22. Mean peduncle length for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. <sup>†</sup>Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Peduncle Length				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- mm -----				
Guymon	128.4	138.6	133.5	16-225	20-231
Saraha	102.0	96.4	99.2	58-182	59-180
Jackpot	94.9	91.5	93.2	30-165	11-150
Mirage	89.7	93.1	91.4	47-162	50-160
Arizona Common	88.4	84.2	86.3	62-156	47-150
Yukon	65.4	74.0	69.7	21-122	18-120
5% LSD	6.3	6.1	5.9	-	-

<sup>†</sup>Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\*Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 23. Mean first internode length of seed stalks for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. <sup>†</sup> Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	First Internode Length of Seed Stalks				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- mm -----				
Guymon	96.5	97.5	97.0	20-226	21-232
NuMex Sahara	51.9	62.9	57.4	28-120	27-119
Jackpot	53.1	48.5	50.8	15-80	21-79
Mirage	52.5	48.9	50.7	25-90	28-93
Arizona Common	41.5	42.7	42.1	21-83	19-82
Yukon	37.5	36.5	37.0	13-69	18-65
5% LSD	6.2	6.1	5.3	-	-

<sup>†</sup>Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\*Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 24. Mean flag leaf sheath length for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. <sup>†</sup> Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Flag Leaf Sheath Length				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- mm -----				
Guymon	96.5	97.5	97.0	51-160	55-164
NuMex Sahara	71.2	76.6	73.9	48-139	46-130
Mirage	62.4	67.2	64.8	45-92	40-93
Arizona Common	61.4	66.2	63.8	29-107	30-106
Jackpot	62.9	58.7	60.8	29-123	24-120
Yukon	55.4	52.8	54.1	15-79	16-80
5% LSD	6.1	5.5	4.2	-	-

<sup>†</sup>Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\*Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 25. Mean mature plant height for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000. † Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Mature Plant Height				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- mm -----				
Guymon	629.7	647.9	638.8	406-765	420-787
Arizona Common	598.3	610.7	604.5	432-780	440-787
NuMex Sahara	567.1	561.8	564.5	390-711	381-705
Mirage	552.9	549.5	551.2	356-762	360-759
Jackpot	415.6	429.0	422.3	235-520	229-572
Yukon	416.7	405.5	411.1	130-533	127-529
5% LSD	52.4	56.5	51.5	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\* Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

Table 26. Mean mature vegetative plant height for seven seed-propagated turf bermudagrass cultivars based on five measurements from each of 60 plants in 1999 and 2000.

† Measurements taken from center of 3<sup>rd</sup> extended internode from the apical meristem. Test located on the Agronomy Research Station, Stillwater, OK.

Cultivar	Mature Vegetative Plant Height				
	Means*			Ranges	
	1999	2000	2 Yr Mean	1999	2000
	----- mm -----				
Guymon	408.6	419.4	414.0 a	297-520	299-533
NuMex Sahara	358.7	367.7	363.2 b	310-432	304-427
Mirage	337.5	358.5	348.0 b	178-450	184-457
Arizona Common	345.9	334.9	340.4 b	203-559	208-549
Jackpot	291.6	302.8	297.2 c	161-381	152-375
Yukon	296.8	287.4	292.1 c	56-483	51-479
5% LSD	46.1	45.2	42.5	-	-

† Test planted June 1998. Plants arranged in a randomized complete block design with four replications. Whole plots were cultivars and subplots were individual plants within cultivars. Measurements were taken on a total of 60 plants per cultivar i.e. 15 plants per cultivar per rep. Data were analyzed using the Statistical Analysis System (SAS).

\* Any two means within a column whose difference exceeds the 5% LSD value are significantly different according to Tukey's Least Significant Difference test.

1 **DNA Fingerprinting of Seeded Bermudagrass Cultivars**

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## ABSTRACT

Bermudagrasses (*Cynodon spp.*) are important for turf and forage in temperate and tropical climates, with cultivars historically propagated clonally. Over the past two decades the number of seed-propagated commercial cultivars has dramatically increased, but information is lacking on the extent of the genetic diversity among these new cultivars. Accordingly, this research was undertaken to assess the genetic relatedness of 17 seed-propagated turf-bermudagrass cultivars using DNA amplification fingerprinting (DAF). Four DAF and four Minihairpin-DAF (MHP-DAF) primers were used in this study. The DAF and MHP-DAF primers amplified 90 and 131 amplicons, respectively. A total of 13 out of the 17 cultivars were practically indistinguishable using the DAF primers with an average similarity (SC) of 0.982, while the MHP-DAF primers distinguished all cultivars readily. Results from the DAF and MHP-DAF analysis indicated that 14 out of the 17 cultivars were related to Arizona common germplasm with average SC of 0.833 in the MHP-DAF analysis. Arizona common germplasm is naturalized to the Colorado River Valley production areas of Arizona and California. The three most distinct cultivars: 'Princess 77', 'Yukon' and 'SWI-11' had an average SC of 0.668. The most distinct cultivar was 'Yukon' with an average SC of 0.604. Yukon showed 59 DNA signatures not observed in the other varieties studied with DAF and MHP-DAF. These results indicated that a majority of seeded-type bermudagrasses developed over the past two decades depend upon a narrow genetic base, and that several recent cultivars are markedly genetically distinct indicating a recent and significant broadening of the germplasm.

1 Bermudagrass (*Cynodon dactylon* L. Pers) is a perennial sod-forming turf and forage grass,  
2 native to India and eastern Africa (Beard 1973; Braun 1967; Correl and Johnson 1970; Duble 1996).  
3 This grass is extensively used in temperate and subtropical regions of the world for agricultural,  
4 recreational and residential use (Duble, 1996). Historically, the highest quality turf bermudagrass  
5 cultivars have been sterile  $F_1$  hybrid plants from crosses between plants of tetraploid ( $2n=4x=36$ ) *C.*  
6 *dactylon* and diploid ( $2n=2x=18$ ) *C. transvalensis* Burt-Davy. These cultivars are commercially  
7 propagated by planting either sprigs or sod. Over the past two decades there has been a dramatic  
8 increase in the number of seed-propagated cultivars. National Turf Evaluation Program (NTEP) data  
9 (NTEP, 2002) indicate some of the recently developed seeded-type bermudagrasses rival the clonal-  
10 standard bermudagrass cultivars in turfgrass quality and other performance characteristics.

11 Several studies have been conducted to examine the genetic relatedness among vegetative  
12 propagated bermudagrass cultivars (Caetano-Anolles, 1995 and 1998a; Zhang, 1999), but no  
13 information has been published concerning diversity among seeded-type bermudagrasses. Several  
14 seeded-type bermudagrass cultivars appear to have originated from the naturalized common form of  
15 bermudagrass grown in Yuma County Arizona and the California Imperial Valley and are generally  
16 referred to as "Arizona Common". This bermudagrass is thought to have been introduced to the US  
17 southwest desert region at least by the middle of the 19<sup>th</sup> century (Kneebone, 1966). Baltensperger et al.  
18 (1993) indicated that a bermudagrass seed industry started soon after 1900 from bermudagrass  
19 naturalized to a region along the Colorado river in Arizona and California. The degree to which current  
20 commercial seeded-type bermudagrass cultivars are genetically interrelated is unknown. Accordingly,  
21 an estimation of genetic diversity of the seeded-type bermudagrass cultivars would provide important  
22 information relative to the need for genetic diversification in breeding programs.

23 Many techniques have been used to determine genetic relationships, including DNA  
24 amplification and fingerprinting (DAF) (Caetano-Anolle's et al., 1997), amplified fragment length  
25 polymorphism (AFLP)(Zhang et al., 1999), and randomly amplified polymorphic DNA (RAPD) (Huff,  
26 1997). All these take advantage of the natural variations inherent in plant DNA. While all are capable,  
27 there are some advantages to each. AFLP is a very powerful and reproducible technique, and is readily  
28 adaptable to automation. However the technique is fairly expensive in terms of reagent cost and  
29 equipment, and requires additional steps to perform when compared to DAF. The DAF technique is a  
30 reliable, low cost, high-resolution method that is capable of revealing many DNA polymorphisms. The  
31 DAF method when compared to the similar technique known as RAPD produces a many-fold increase  
32 in polymorphism per primer (de Vienne et al., 2003).

1       A variant of DAF that utilizes short minihairpin primers further increases the resolving power of  
2 the DAF technique. In one study, the MHP primers detected 5 times as many bermudagrass  
3 polymorphisms as conventional DAF primers (Caetano-Anolle's et al., 1995). MHP-DAF primers  
4 contain palindromic sequences which hybridizes through intra-primer interactions creating a hairpin and  
5 a small looped priming structure (Caetano-Anolle's and Gresshoff, 1994). The MHP-DAF technique  
6 uses previously amplified DAF amplicons as template to generate further banding pattern diversity.

7       DAF has been used successfully to determine the phylogenetic relationships among  
8 bermudagrass species (Assefa et al., 1999), provide information on the origin of off-type bermudagrass  
9 cultivars (Caetano-Anolles, 1998b), and determine the fidelity of bermudagrass commercially sold as  
10 'U-3' (Anderson et al., 2001), a cultivar originally developed in the early 1930's. Accordingly, this  
11 project was undertaken with the objective of determining the genetic relatedness of selected seeded-type  
12 bermudagrass cultivars. In this study we analyzed 17 seeded cultivars from different backgrounds using  
13 DNA amplification fingerprinting.

## MATERIAL AND METHODS

### Plant Materials

The seeds of bermudagrass cultivars were obtained from the suppliers listed in Table 1. Approximately 4500 seeds of each cultivar were planted in a 15 cm diameter pot containing Metro mix 250 (Scotts-Sierra, Marysville, OH). The high seeding rate was used to insure that the resulting plant populations would be representative of the cultivars. Plants were fertilized with Peters Professional Peat-Lite (Scotts- Sierra, Marysville, OH) and Iron Chelate (Miller Chemical and Fertilizer Corp., Hanover, PA). The plants were fungicide treated with Chlorothalonil: [2,4,5,6-tetrachloroisophthalonitrile] (trade name: Daconil, Ortho group, Columbus, OH) at a rate of 4.2 ml/L and with Aldecarb: [2-Methyl-2-(methylthio)propionaldehydeO-(methylcarbamoyl oxime)] (trade name Temik, Union Carbide Inc., NC).

### DNA Isolation

A total of two g of leaf tissue was harvested from a single pot containing each cultivar. The leaf tissue was frozen in liquid nitrogen and ground in a mortar and pestle to a fine powder. Genomic DNA was isolated from 100 mg of powdered leaf tissue using the DNeasy plant mini-extraction kit (Qiagen Inc., Valencia CA) according to directions provided by the supplier. The DNA concentration was assessed spectrophotometrically at 260 nm and quality was assessed by the 260/280 ratio (Sambrook et al. 1989). If one or more DNA extracts of the batch of 17 cultivars showed a 260/280 ratio less than 1.8 the entire batch was extracted again. The DNA was suspended to a final concentration of 5 ng/L in 0.5X TE and stored at 4° C. DNA quality was further assessed by TBE agarose gel electrophoresis. All samples showed no sign of DNA degradation.

### PCR Amplification

Four DAF and four MHP-DAF primers (Table 2) were used to fingerprint the 17 bermudagrass cultivars used in this study. The PCR amplification mixture consisted of 2.5 U of Qiagen *Taq* polymerase (Qiagen Inc., Valencia, CA) 10X PCR buffer which included  $MgCl_2$  for a final concentration of 1.5 mM, 250  $\mu$ M dNTP, 1.5  $\mu$ M DAF primers (Integrated DNA Technologies Inc, Corelville, IA), and 0.5 ng of template DNA, with the final volume made to 20  $\mu$ l with sterile distilled water. The DNA template was initially denatured at 94° C for 60 seconds. Following denaturation, PCR proceeded at 94° C for 30 seconds, then 30° C for 30 seconds and 72° C for 30 seconds, cycling back 39 times. A final extension at 72°C for 60 seconds at the end of the 39 cycles was performed. The PCR products were

1 visualized on a 1% TBE agarose gel impregnated with ethidium bromide at a final concentration of 0.5  
2  $\mu\text{g/ml}$ .

3 The gel was examined to assure that the overall fingerprint intensity was nearly equal among all  
4 lanes. If PCR failed to amplify a fingerprint in any one of the 17 reactions then the entire set was re-run  
5 until the fingerprints were near equally amplified. Conditions for MHP-DAF were the same as for DAF  
6 except that one  $\mu\text{L}$  of DAF PCR product was used instead of the genomic DNA template. We also found  
7 that adding 6 mM  $\text{MgCl}_2$  improved performance of the MHP-DAF.

#### 8 **Denaturing Polyacrylamide Electrophoresis**

9 PCR products were separated on a 20 cm long 6% acrylamide denaturing PAGE gel using a Bio  
10 Rad Protean II apparatus (Bio Rad, Richmond CA). The gel was made with Long Ranger Acrylamide  
11 (Cambrex Bio Science Inc., Rockland, ME) 1 X TBE and 7.1 M urea. A total of seven  $\mu\text{L}$  of PCR  
12 products with three  $\mu\text{L}$  of loading buffer containing the tracking dye bromphenol blue were mixed and  
13 loaded onto the gel. Molecular markers were loaded on either side of the lanes containing the PCR  
14 amplicons. Electrophoresis continued at 80 volts until the bromophenol blue strain reached three-  
15 quarters of the length of the gel. The gel was removed and stained with silver using a Bioneer silver  
16 staining kit (BioNexus, Oakland, CA) according to manufacturer directions. After staining, the gel was  
17 equilibrated in 10% (v/v) glycerol and 20 % (v/v) ethanol, covered with cellophane and air dried at room  
18 temperature for a week prior to analysis. All 17 PCR products were run on the same gel to facilitate  
19 accurate band-to-band comparisons.

20

#### 21 **Data Profiling and Analysis**

22 After silver staining, electrophoretic bands of less than 1.5 kD were scored for their presence  
23 (1) or absence (0) for each cultivar. The data were compiled in a Excel spreadsheet and imported into  
24 the NTSYS software version 2.0 (Exeter Software, New York, NY) for cluster analysis. Similarity  
25 coefficients (SC)(Table 3) were computed by the SIMQUAL module. Cluster analysis was performed  
26 according to the unweighted pair group mean algorithm (UPGMA) within the SAHN module of the  
27 NTSYS program. The PCR reaction, electrophoresis separation, staining of gels, data profiling and  
28 analysis was replicated two to three times. Comparisons showed that there were either no differences, or  
29 only very minor differences, between replicate experiments.

30

## RESULTS AND DISCUSSION

A total of 90 and 131 bands were scored for DAF and MHP-DAF, respectively (Fig 1). Over 87% (78 bands) and 79% (103 bands) were found to be polymorphic in the bulked samples using DAF and MHP-DAF, respectively, meaning that the band was present in at least one cultivar but was not observed in others.

The DAF results indicated that 13 out of the 17 bermudagrass cultivars were very closely related to each other (Fig. 2a) with an average SC of 0.982 (data not shown). The other four cultivars, Riveria, Princess, SWI1-1 and Yukon were easily distinguishable using DAF. The technique of DAF alone could not resolve differences between Arizona Common and CD 90160 or differences among 'Mohawk', Savannah, Southern Star, 'Sundevil' and 'Numex Sahara' (Fig. 2a, SC = 1.000). In contrast, the MHP-DAF analysis clearly differentiated among all 17 cultivars (Fig. 2b). The differences between DAF and MHP-DAF were even more dramatic with 14 of the most closely related cultivars in the MHP-DAF analysis showing an average SC of 0.833, while in the DAF analysis these same cultivars showed an average SC of 0.975 (data not shown). The results from the MHP-DAF and DAF analysis indicated that 14 of the cultivars in this study were closely related to Arizona Common. This group included Arizona Common, 'CD90160', 'Jackpot', 'Majestic', Savannah, Southern Star, Sundevil, Mohawk, Riviera, 'Mirage', 'Sydney', 'Pyramid', Numex Sahara, and 'Transcontinental'.

According to MHP-DAF analysis, the most closely related cultivars grouped into three clusters, including: Arizona Common and CD90160 (group 1, SC 0.901), Savannah, Southern Star, and Sundevil (group 2, average SC 0.913), and Numex Sahara and Transcontinental (group 3, SC 0.901). The two most similar cultivars were Savannah and Southern Star with a SC of 0.924. The pedigree information available for Savannah (Fraser and Rose-Fricker, 1998) and Southern Star (Samudio and Brede, 2002) indicate that bermudagrass germplasm from Walla Walla, Washington, collected by the respective developers, contributed to the parentage of both cultivars. The use of additional markers may even better differentiate the closely related Arizona Common-type bermudagrasses.

Yukon, Princess 77 and 'SWI-11' were least genetically related to Arizona Common of all the cultivars studied. Furthermore, all three cultivars showed little relationship to each other. Yukon was the most distinct cultivar in this study with an average SC of 0.604 across all cultivars. The least similar cultivar to Yukon was SWI-11 and the most similar was Transcontinental, with SCs of 0.511 and 0.649, respectively. These low SCs indicate that Yukon was the most divergent seeded-type bermudagrass cultivars of those studied. Furthermore, 36 bands from Yukon were not observed in other cultivars tested, and 23 bands were found in all other bermudagrasses studied except Yukon. Combining those

1 bands not observed with those uniquely observed in Yukon totalled 59 potential DNA signatures  
2 representing over 27 % of the bands scored. Yukon is a new cultivar recently released by Oklahoma  
3 State University. Two other distinct cultivars Princess 77 and SWI-11 had average SCs of 0.689, and  
4 0.712, respectively. Both Princess 77 and SWI-11 showed 7 signatures not observed in other cultivars in  
5 the combined DAF and MHP-DAF studies, or 3% of all bands scored. These DNA signatures may be  
6 useful for cultivar maintenance and identification purposes.

7 The close clustering of the 14 out of 17 cultivars with DAF indicated that most seeded-type  
8 bermudagrass cultivars are very closely related. Included in this group is Arizona Common, indicating  
9 that many of the cultivars likely originated from breeding populations originally constituted solely, or  
10 substantially, from Arizona Common. A second potential reason for some cultivars showing close  
11 similarity to Arizona Common relates to mechanical contamination of seed production fields leading to  
12 genetic contamination. Seed of many of the cultivars in the study were produced in Yuma Co., Arizona  
13 or the Imperial Valley, California where bermudagrass seed production has been concentrated for nearly  
14 a century. Preventing the Arizona Common bermudagrass ubiquitous to this region from mechanically  
15 contaminating unique cultivar seed production fields and hybridizing with plants of the unique cultivars  
16 is difficult. Seed production fields of cultivars that are less well adapted to the region than Arizona  
17 Common can quickly be dominated by the latter. Arizona Common growing as an impurity in seed  
18 production fields, or growing in adjacent areas, may hybridize with the cultivars resulting in genetic  
19 contamination of the desired cultivar. One of the authors (C. M. Taliaferro) has observed seed  
20 production fields of cultivars that were less well adapted to the region than Arizona Common become  
21 dominated by the latter within 1 to 3 years contingent on the amount of initial contaminant Arizona  
22 Common in the stand. Arizona Common growing as contaminant in cultivar seed-production fields, or  
23 growing in adjacent areas, has the potential of hybridizing with the cultivars. Hoff (1967) demonstrated  
24 natural crossing between Arizona Common and giant bermudagrass (*C. dactylon* var. *aridus*), the two  
25 major forms of bermudagrass traditionally grown in the region. However, the progeny resulting from  
26 the hybridization of tetraploid Arizona Common and diploid giant bermudagrass plants were sterile  
27 triploids. Such hybridization between tetraploid cultivars could produce fertile progeny leading to  
28 genetic contamination. Relative to the usually sterile vegetatively-propagated bermudagrass cultivars  
29 the potential for genetic changes in seeded-type bermudagrass cultivars is greater and warrants  
30 additional actions to maintain their genetic fidelity.

31 It should be noted that significant differences exist among the cultivars grouped with Arizona  
32 Common for turf quality, cold tolerance, and other performance traits (National Turfgrass Evaluation

Program, 1997, 2002). Notably, Riviera, though loosely grouped with Arizona Common on the basis of SC values, has much higher turf quality and broader adaptation due to greater cold tolerance. None of the seed-propagated cultivars in the 1992 NTEP trial had turfgrass quality ratings as high as the vegetatively-propagated standard cultivars in the test. Results from the 1997 NTEP bermudagrass test indicated that the development of Princess and Riviera represented a major gain in turfgrass quality for seeded-type bermudagrasses relative to industry-standard clonal cultivars. The development of these two cultivars suggests that major gains in performance can be achieved by breeding in relatively diverse germplasm pools with the desired result of maintenance of genetic diversity among cultivars.

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**FIGURES**

- 1
- 2
- 3 Figure 1. MHP-DAF electrophoresis gel stained with silver containing PCR amplicons from 17 cultivars
- 4 of bermudagrass.
- 5
- 6 Figure 2. DENDROGRAMs from DAF (a) and MHP-DAF (b) analysis of 17 seeded-type bermudagrass
- 7 cultivars.

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1 Table 1. Seeded-type bermudagrass cultivars used in this study and their source

2

Cultivar	Source
Arizona Common	Seeds West, Inc., Roll, AZ
CD 90160	Cebeco International Seeds, Inc., Halsey, OR
Jackpot	Simplot Turf and Horticulture, Boise, ID
Majestic	H & H Seed company Inc., Yuma, AZ
Mirage	Cebeco International Seeds, Inc., Halsey, OR
Mohawk	Seeds West, Inc., Roll, AZ
Pyramid	Cebeco International Seeds Inc., Halsey, OR
Princess 77	Seeds West Inc., Roll, AZ
Riviera	Oklahoma State University, Stillwater, OK
Savannah	Turf Seed Inc, Hubbard, OR
Southern Star	Simplot Turf and Horticulture, Boise, ID
Sundevil	Simplot Turf and Horticulture, Boise, ID
SWI-11	Seeds West Inc., Roll, AZ
Sydney	Seeds West Inc., Roll, AZ
Numex Sahara	Seeds West Inc., Roll, AZ
Transcontinental	Pure Seed Testing, Inc., Hubbard, Or
Yukon	Oklahoma State University, Stillwater, OK

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1 Table 2. Sequence of the DAF and MHP-DAF primers used in this study.

2

Primer Label	Primer Sequence
DAF 9110	CAGAAACGCC
DAF 9111	GAAACGCC
DAF 9112	GTAACGCC
DAF 9113	GTAACCCC
MHP-DAF 1	GCGAAGCGGA
MHP-DAF 2	GCGAAGCTACG
MHP-DAF 3	GCGAAGCCTA
MHP-DAF 4	GCGACAGCAGA

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Varieties	Arizona Common	CD9010	Jackpot	Majestic	Mirage	Mohawk	Pyramid	Princess 77	Riviera	Savannah	Southern Star	Sundevil	SWI-11	Sydney	Numex Sahara	Transcontinental	Yukon
Arizona Common	0.901	1.000															
CD9010	0.878	0.885	1.000														
Jackpot	0.855	0.878	0.870	1.000													
Majestic	0.809	0.817	0.840	0.832	1.000												
Mirage	0.878	0.855	0.847	0.855	0.855	1.000											
Mohawk	0.786	0.809	0.786	0.824	0.824	0.847	1.000										
Pyramid	0.656	0.664	0.672	0.710	0.710	0.733	0.718	1.000									
Princess 77	0.817	0.794	0.878	0.794	0.824	0.863	0.786	0.718	1.000								
Riviera	0.855	0.847	0.855	0.863	0.832	0.870	0.794	0.695	0.824	1.000							
Savannah	0.870	0.847	0.885	0.893	0.878	0.885	0.840	0.710	0.855	0.924	1.000						
Southern Star	0.855	0.847	0.870	0.863	0.817	0.855	0.809	0.725	0.733	0.725	0.786	1.000					
Sundevil	0.733	0.695	0.733	0.725	0.725	0.733	0.672	0.756	0.733	0.725	0.786	0.740	1.000				
SWI-11	0.786	0.809	0.786	0.855	0.855	0.817	0.802	0.687	0.802	0.824	0.870	0.809	0.718	1.000			
Sydney	0.802	0.824	0.832	0.840	0.840	0.832	0.832	0.687	0.771	0.794	0.840	0.794	0.702	0.847	1.000		
Numex Sahara	0.794	0.817	0.855	0.786	0.832	0.824	0.824	0.649	0.779	0.771	0.832	0.756	0.710	0.794	0.901	1.000	
Transcontinental	0.611	0.603	0.626	0.618	0.603	0.626	0.595	0.542	0.611	0.618	0.603	0.603	0.511	0.626	0.611	0.649	1.000
Yukon																	

Table 3. Similarity coefficient table (SC) using MHP-DAF analysis

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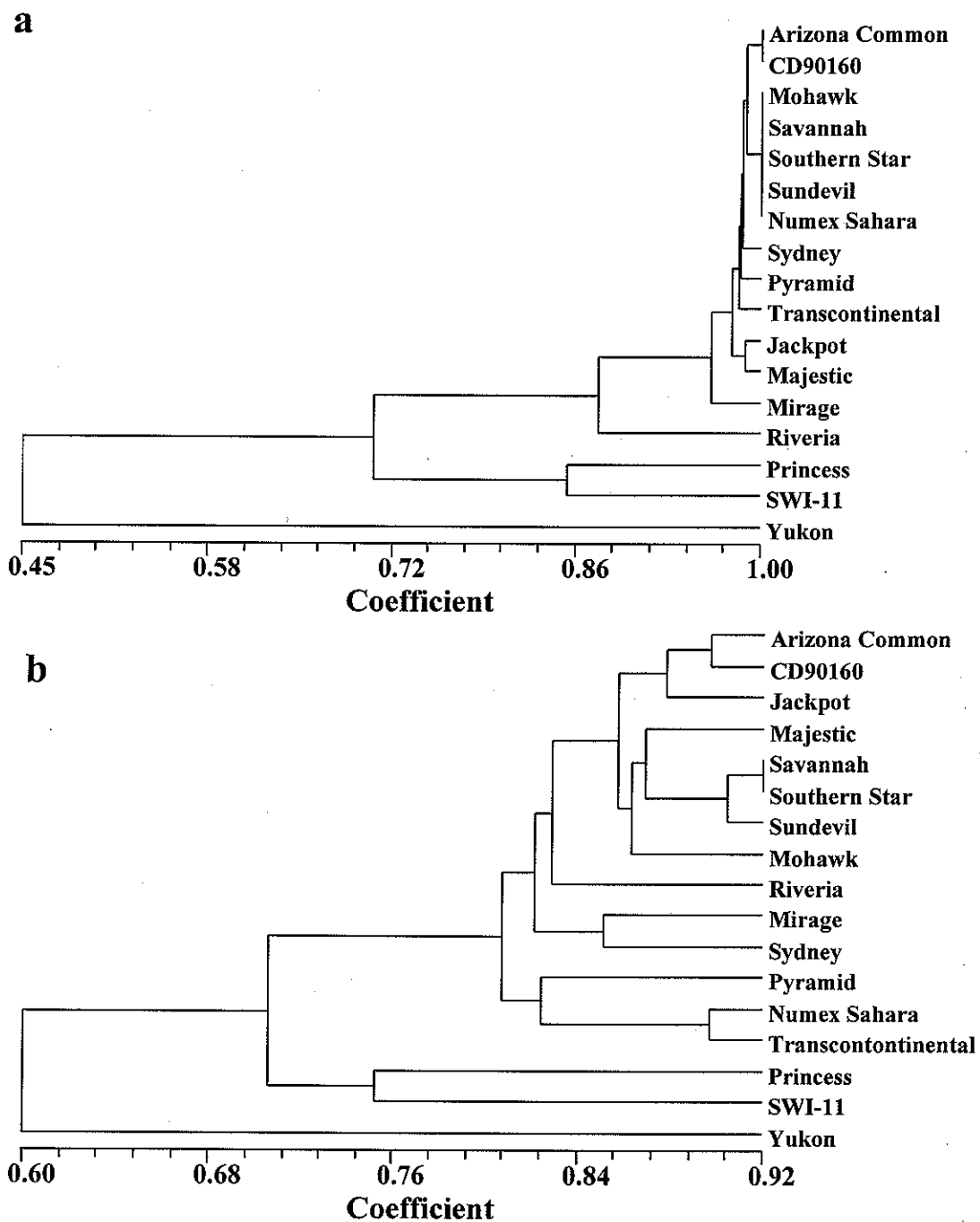


Figure 2. DENDROGRAMs from DAF (a) and MHP-DAF (b) analysis of 17 seeded-type bermudagrass cultivars.

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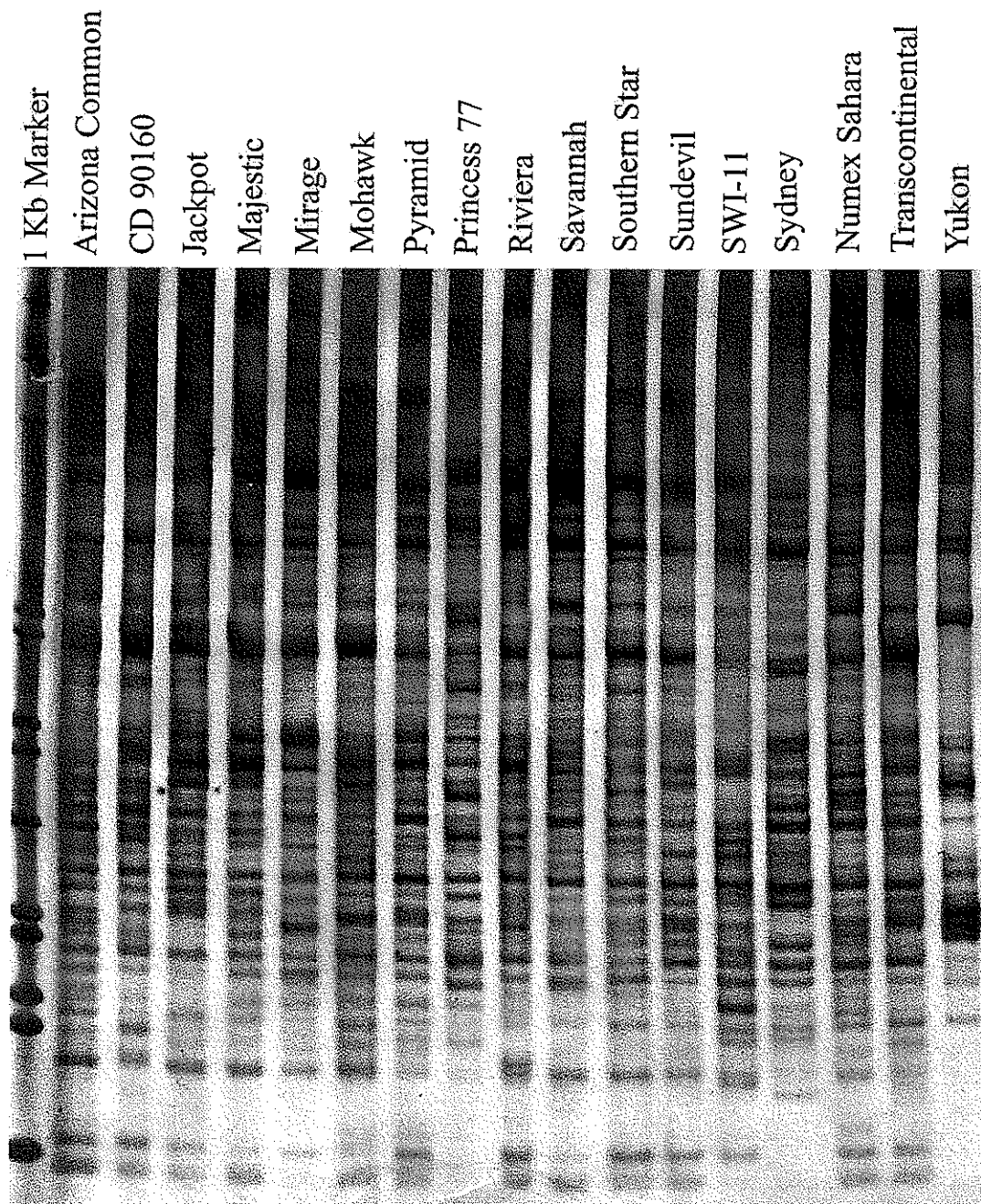


Figure 1. MHP-DAF electrophoresis gel stained with silver containing PCR amplicons from 17 cultivars of bermudagrass.

U.S. DEPARTMENT OF AGRICULTURE  
AGRICULTURAL MARKETING SERVICE**EXHIBIT E**  
**STATEMENT OF THE BASIS OF OWNERSHIP**

The following statements are made in accordance with the Privacy Act of 1974 (5 U.S.C. 552a) and the Paperwork Reduction Act (PRA) of 1995.

Application is required in order to determine if a plant variety protection certificate is to be issued (7 U.S.C. 2421). Information is held confidential until certificate is issued (7 U.S.C. 2426).

1. NAME OF APPLICANT(S)  
Oklahoma Agricultural Experiment Station2. TEMPORARY DESIGNATION  
OR EXPERIMENTAL NUMBER  
OKS 91-113. VARIETY NAME  
Yukon4. ADDRESS (Street and No., or R.F.D. No., City, State, and ZIP, and Country)  
Oklahoma State University  
139 Agricultural Hall  
Stillwater, OK 74078-60195. TELEPHONE (include area code)  
405-744-53986. FAX (include area code)  
405-744-5339

7. PVPO NUMBER

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8. Does the applicant own all rights to the variety? Mark an "X" in appropriate block. If no, please explain.

☒ YES☐ NO

9. Is the applicant (individual or company) a U.S. national or U.S. based company?

☒ YES☐ NO

If no, give name of country

10. Is the applicant the original owner?

☒ YES☐ NOIf no, please answer one of the following:

a. If original rights to variety were owned by individual(s), is (are) the original owner(s) a U.S. national(s)?

☐ YES☐ NO

If no, give name of country

b. If original rights to variety were owned by a company(ies), is(are) the original owner(s) a U.S. based company?

☒ YES☐ NO

If no, give name of country

11. Additional explanation on ownership (if needed, use reverse for extra space):

Yukon was developed by and wholly owned by the Oklahoma Agricultural Experiment Station, Oklahoma State University.

**PLEASE NOTE:**

Plant variety protection can be afforded only to owners (not licensees) who meet one of the following criteria:

1. If the rights to the variety are owned by the original breeder, that person must be a U.S. national, national of a UPOV member country, or national of a country which affords similar protection to nationals of the U.S. for the same genus and species.
2. If the rights to the variety are owned by the company which employed the original breeder(s), the company must be U.S. based, owned by nationals of a UPOV member country, or owned by nationals of a country which affords similar protection to nationals of the U.S. for the same genus and species.
3. If the applicant is an owner who is not the original owner, both the original owner and the applicant must meet one of the above criteria.

The original breeder/owner may be the individual or company who directed final breeding. See Section 41(a)(2) of the Plant Variety Protection Act for definition.

According to the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0581-0055. The time required to complete this information collection is estimated to average 10 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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